Electricity Markets and the Simplex Algorithm



With worked examples using the Simplex Nodal app

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Introduction

This document explains nodal electricity markets and the simplex algorithm, supported by worked examples.

The first section provides an overview of electricity markets and electricity networks. This overview is followed by a series of tutorials that add detail by building models of electricity markets and electricity networks and solving them using the simplex algorithm. You can build and solve the models yourself by using the Simplex Nodal app, which is free software available for iPhone, iPad or Mac.

The first tutorial demonstrates how a very simple nodal electricity market can be represented mathematically as a linear programming model and solved using the simplex algorithm. When the model is solved, the results are explained.

The remaining tutorials follow a similar pattern of demonstrating features of electricity markets by building and solving example models, and then explaining the results. Electricity market features that are covered include the modelling of the transmission system, line losses, parallel flows, binding constraints, the spring washer effect, risk and reserve, ramp rates, HVDC links, HVDC risk and the risk subtractor, HVDC reserve sharing, and modelling part of an actual electricity market.

In every tutorial the feature being explained is expressed in terms of the mathematical model that can be solved by the simplex algorithm. The final tutorial explains the simplex algorithm itself in detail, covering the initial tableau, basic and nonbasic variables, the steps that the simplex algorithm takes in order to improve the objective value, and how the results are extracted from the final tableau.

The remainder of the document provides a user guide for the Simplex Nodal app, with a section that describes in how to use the app to build and solve electricity market models in general, followed by a section that describes how to use all of the controls and displays.